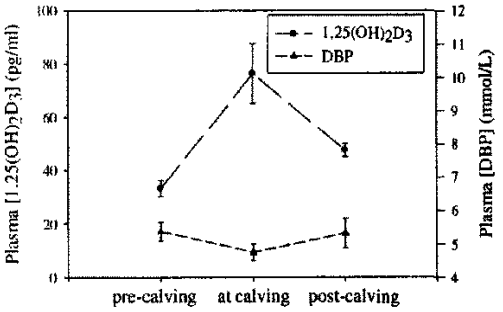
Characteristics of vitamin D transport in peri-parturient dairy cows

CJ Laing, ML Hyde and DR Fraser

Department of Animal Science, The University of Sydney, NSW 2006

Serum concentrations of 1,25-dihydroxyvitamin D_3 ($1,25(OH)_2D_3$) are known to be increased during pregnancy in humans and rats (1). The concentration of plasma vitamin D-binding protein (DBP) has also been found to increase during pregnancy, however the "free", or biologically available fraction of $1,25(OH)_2D_3$ remains unaltered until the final few days of gestation when $1,25(OH)_2D_3$ concentrations rise rapidly (2). This increase in plasma concentration of $1,25(OH)_2D_3$ has also been observed in cows at calving (3). Although there is little doubt that alterations in the metabolism and handling of vitamin D play a role in the peri-parturient calcium homeostatic mechanism, it has been difficult to establish a particular role for DBP in this process.

Plasma was collected from thirteen dairy cows (15 - 32 months of age), approximately three weeks prior to calving, within 24 hours of parturition, and approximately three weeks post-calving. Concentrations of $1,25(OH)_2D_3$ were measured by competitive protein binding assay. DBP concentrations were estimated by saturation analysis using increasing concentrations of 3H-25-hydroxyvitamin D_3.



Plasma concentrations of DBP were found to be significantly lower (4.75 x 0.25 µmol/L) in cows at parturition, as compared to late gestation (5.36 x 0.27 µmol/L). In contrast, calving concentrations of plasma $1,25(OH)_2D_3$ were significantly higher than either of the other two time periods ($P=0.001$, $P=0.04$).

There were no differences in total plasma protein, albumin or creatinine kinase concentrations.

The decline in plasma DBP concentration accompanied by a simultaneous increase in $1,25(OH)_2D_3$ concentration associated with parturition would almost certainly result in an increase in the "free" fraction of the hormone, and thus an increased availability of the compound for cellular uptake. These changes could represent a mechanism by which dairy cows increase calcium absorption from the GIT to meet the demands of early lactation.

1. Kumar R, Cohen WR and Epstein FH. Vitamin D and calcium hormones in pregnancy. N Engl J Med 1980; 301:1143 - 1145
2. Bouillon R, Van Assche FA, Van Baelen H, Heyns W and DeMoor P. Influence of the vitamin D binding protein on the serum concentration of 1,25-dihydroxyvitamin D3. J Clin Invest 1981; 67:589 - 596
3. Hyde ML and Fraser DR. Manipulating the cow's calcium reserves to minimise milk fever. In: Gooden J ed. Current Topics in Dairy Production vol 1. Dairy Research Foundation, The University of Sydney, 1996:90 - 97